DEVELOPMENT OF A NEW DESIGN OF A BELT CONVEYOR GUIDE ROLLER MECHANISM AND CALCULATION OF VIBRATION AMPLITUDE

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ABSTRACT. This article discusses the development of a new design of a roller mechanism for a belt conveyor guide widely used in the mining industry. External impacts and loads acting on the roller mechanism are analyzed, and their influence on the dynamic behavior of the system is investigated. A mathematical model is developed to determine the vibration amplitude and angular velocity of the mechanism during operation. The effectiveness of applying elastic-element sliding bearings to reduce vibrations and improve structural reliability is substantiated.

Keywords: belt conveyor, roller mechanism, external impact, loading, vibration, amplitude, angular velocity, belt element, sliding bearing, dynamics, parameter.

ANNOTATSIYA. Mazkur maqolada tog‘-kon sanoati korxonalarida keng qo‘llaniladigan tasmali konveyer yo‘naltiruvchi rolikli mexanizmining yangi

konstruksiyasini ishlab chiqish masalalari yoritilgan. Ish jarayonida rolikli mexanizmga ta’sir etuvchi tashqi zarb va yuklanish omillari tahlil qilinib, ularning tizim dinamikasiga ta’siri o‘rganilgan. Mexanizm harakatida yuzaga keladigan tebranish amplitudasi va burchak tezlik ko‘rsatkichlarini aniqlash uchun matematik model ishlab chiqilgan. Shuningdek, konstruksiyada qayishqoq elementli sirpanish podshipniklarini qo‘llash orqali tebranishlarni kamaytirish va ishonchlilikni oshirish imkoniyatlari asoslab berilgan.

Tayanch so‘zlar: tasmali konveyer, rolikli mexanizm, tashqi zarb, yuklanish, tebranish, amplituda, burchak tezlik, qayishqoq element, sirpanish podshipnik, dinamika, parametr.

АННОТАЦИЯ. В данной статье рассматриваются вопросы разработки новой конструкции роликового механизма направляющего устройства ленточного конвейера, широко применяемого в горно-промышленной отрасли. Проанализированы внешние удары и нагрузки, воздействующие на роликовый механизм, а также их влияние на динамику системы. Разработана математическая модель для определения амплитуды колебаний и угловой скорости механизма в процессе эксплуатации. Обоснована эффективность применения подшипников скольжения с упругим элементом для снижения вибраций и повышения надёжности конструкции.

Ключевые слова: ленточный конвейер, роликовый механизм, внешнее воздействие, нагрузка, вибрация, амплитуда, угловая скорость, элемент ленты, подшипник скольжения, динамика, параметр.

In the mining and metallurgical industry, the study of belt conveyors is mainly characterized by determining the location of their belts, the guide roller mechanism, its use, technological maintenance and lubrication capacity regulation. We can see the guide roller mechanism as the main working part of the belt conveyor. The guide roller

mechanism mainly provides the supporting rotational movement of the belt conveyor. One of the important aspects of this mechanism is related to damage caused by various external influences. Constant dust, water, increased humidity and, of course, external shocks and deformations lead to a decrease in the service life of the mechanism [1].

Rolling bearings, which provide smooth rotational motion in any machine and mechanism, transmit vibrations on shafts and axles directly to the body of the machine mechanism. This situation, of course, leads to an increase in vibration noise of machine mechanisms. The material that acts as a sliding support, namely graphite-caprolon, works by sliding relative to the shaft.

This high-strength material is used as an outer coating to prevent damage due to external influences. This material absorbs external shocks and deformations, which increases the operating cycle of the mechanism. In addition, this detail provides vibration damping in the presence of radial forces in the mechanism and reduces various vibrations by absorbing external forces [2-4].

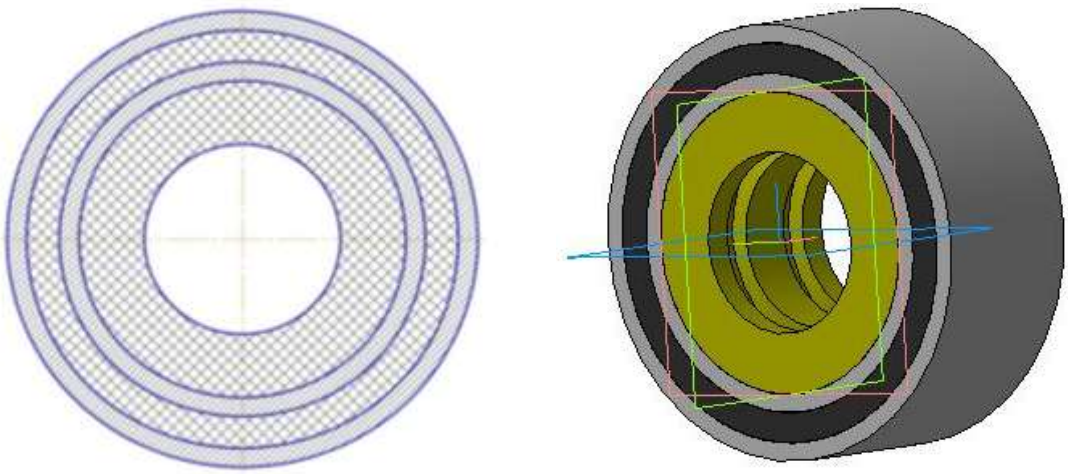
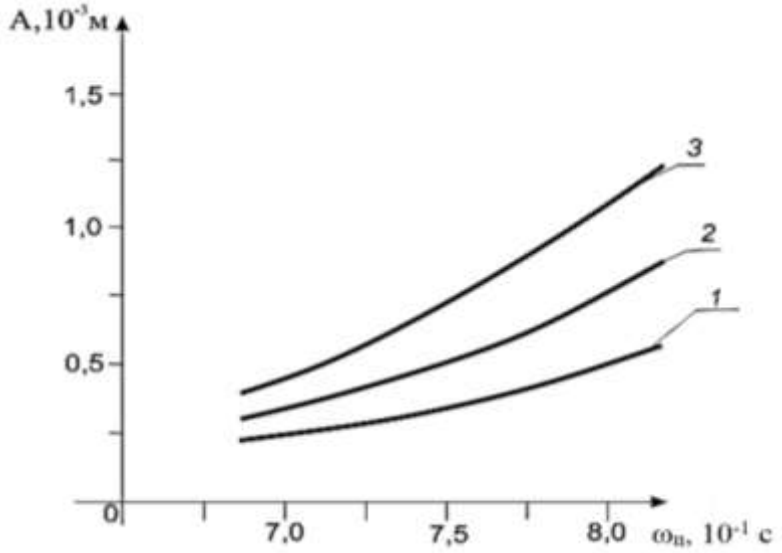


FIGURE 1. Sliding bearing with a sliding element (Roller mechanism)

It is important to study the effect of a composite elastic element and a part made of plastic material on the vibration amplitude relative to the axis. Based on the numerical

solution of this problem, we construct graphs of system parameters. We can see that with an increase in the angular velocity of the guide roller mechanism, its vibration amplitude increases regularly according to a linear diagram (Figure 2) [5,6].

Thus, when ω_s changes from 68 c^{-1} to 80.2 c^{-1}, the vibration amplitude increases from $0.205 \cdot 10^{-3}$ m to $0.61 \cdot 10^{-3}$ m. The cylindrical body on which the part acting as a sliding support is mounted is 0.35 kg, and when m_{xb} = 0.75 kg, the amplitude A increases from $0.42 \cdot 10^{-3}$ m to $1.409 \cdot 10^{-3}$ m. Taking into account the results of experimental studies, the support of the part acting as a sliding support mounted on the axis of the composite guide roller mechanism at high vibration is in the range of $(0.3 \div 0.38) \cdot 10^{-3}$ m. The recommended values to ensure these values are: m_{xb} = (0.35 ÷ 0.4) kg; ω_s = (7.4 ÷ 7.8)·10 c^{-1} [7, 8].



where, in 1 m_{xb} = 0.35 kg; in 2 m_{xb} = 0.55 kg; in 3 m_{xb} = 0.75 kg

FIGURE 2. Graphs of the dependence of the vibration amplitude of the roller mechanisms of the belt conveyor

As a result of this research, a new design of the belt conveyor guide roller mechanism used in mining enterprises was developed and its performance was theoretically substantiated. The external shock and load factors affecting the roller

mechanism were analyzed, and their effect on the vibration amplitude and angular velocity indicators occurring in the system was determined. The developed mathematical model made it possible to calculate the main parameters of the vibration process and evaluate the effectiveness of design changes. It was proven that the use of sliding bearings with elastic elements can reduce vibration loads, ensure stable operation of the mechanism, and extend its service life. The results obtained are of practical importance in the processes of increasing the reliability of belt conveyor systems and their modernization.

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